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## A SYNOPSIS OF THE NEW ENGLAND SPECIES OF MICRASTERIAS.

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THE genus *Micrasterias* includes some of the largest and most showy of the Desmids. The cells are usually disc-shaped and sub-circular in outline, cut into many divisions by more or less radiately arranged incisions. Species are often very common in certain areas, but many of them seem limited to lakes or bodies of water of some size. There are twenty-two species given here for New England and this number is probably fairly complete. There are eighteen species given in the Wests' British Desmids. Two of the British species have not been found as yet in America and a third one while reported from the United States has not been found in New England. On the other hand eight of the species given here have not been found in the British Isles and certain of these seem to be peculiar to America. Some of these eight, such as *M. foliacea*, *M. Nordstedtiana* and *M. muricata* are very different in type from others of the genus. The figures given in Wolle's Desmids of the United States were much conventionalized and therefore it is often hard to say just what Wolle actually saw. The same is true of the reported localities where the identification of the species depended upon Wolle's figures. In this genus however this difficulty is much less than is the case of certain other more difficult genera. As shown by Johnson (Bot. Gaz. 1894) the species of *Micrasterias* are very variable. According to the Wests this variability is much greater in American than in British specimens. However as many of these so called varieties are often seen forming one semicell of a specimen, the other semicell of which is typical, it seems hardly wise to recognize them as good varieties.

Many of the species are represented by mounted slides in my own

collection. In nearly all cases there is a single specimen of the species in a central position and alone on the slide so that it may be easily found. These are referred to by number, e. g. H. C. no. 701, etc. Reference is occasionally made to the slides of the Johnson collection now the property of the Cryptogamic Department of Harvard University. These are referred to as H. J. no. 650, etc. All localities from which specimens have been actually examined by the writer are followed by an exclamation point. In other cases the author's name in parentheses follows the record. Enough of the synonymy is given under each species to refer to the original place of publication and to published figures. Measurements are from New England specimens only, unless otherwise stated. A key is given which will help in the identification of the species.

#### MICRASTERIAS Agardh, 1827.

Cells usually large, commonly sub-circular or elliptical in outline, deeply constricted; semicells usually five lobed, occasionally three lobed, much compressed; polar lobe broadening distally, frequently with a median notch at the middle of the outer border; lateral lobes usually dichotomously divided; zygospores globose, with stout spines; surface often ornamented, usually with acute granules.

#### A KEY TO THE NEW ENGLAND SPECIES OF MICRASTERIAS.

- A. Polar lobe entire or slightly retuse, lateral lobes of semicells two, transversely placed, generally entire and attenuated to their extremities.
1. Polar lobe fusiform, end strongly convex.
    1. Polar lobe narrower and smaller than the basal lobes. 1. *M. oscitans*.
    2. Polar lobe nearly as wide as basal lobes and of similar size. 2. *M. laticeps*.
  - II. Polar lobe spreading, usually with a retuse end.
    1. Apices of polar lobe bifid, narrower than basal lobes. 3. *M. pinnatifida*.
    2. " " " " acute, nearly as wide as " " 4. *M. arcuata*.
- B. Lateral lobes of semicells four, radiately disposed and broadest distally.
- I. Polar lobe entire, lateral lobes barely divided. 5. *M. depauperata*.
  - II. " " with a median incision.
    1. Lateral lobes generally much divided, interlobular incisions narrow.
      - a. Interlobular incisions not deep.
        - (1) Depth of polar lobe much less than half the length of the semicell.
          - (a) Cell nearly as broad as long, smooth. 6. *M. truncata*.
          - (b) " much longer than broad, surface granular. 7. *M. Jenneri*.
        - (2) Depth of polar lobe at least half the length of the semicell. 8. *M. conferta*.
      - b. Interlobular incisions deep.

- (1) Polar lobe prominently exerted. 9. *M. apiculata*.
- (2) " " not prominently exerted.
  - (a) Cell without spines or spinose projections. 10. *M. denticulata*.
  - (b) " with " " " "
    - aa. Polar lobe very narrow, sides parallel for most of their length, sinus undulate. 11. *M. sol.*
    - bb. Polar lobe broader, gradually broadening from the base, sinus not undulate.
      - \* A spine on either side of the terminal notch, interlobular incisions with a row of denticulations. 12. *M. papillifera*.
      - \*\* No spines close to terminal notch, no surface ornamentation. 13. *M. rotata*.
    - cc. Polar lobe broad and anvil shaped at apex, angles uncinatae.
      - 8a. *M. conferta*, var. *hamata*.
- 2. Lateral lobes with fewer divisions, interlobular incisions widely open.
  - a. Polar lobe without processes, lateral lobes unequal, upper one with three, lower with two lobules. 14. *M. Torreyi*.
  - b. Polar lobe with long processes, lateral lobes typically equal and each with two lobules elongated into processes. 15. *M. radiata*.
  - c. Polar lobe without long processes, lateral lobes equal but not elongated into processes. 16. *M. crux-melitensis*.
- C. Polar lobe with accessory processes one on either side of the lobe asymmetrically, not broadened distally as in B.
  - I. Lateral lobes each divided, divisions broad and obliquely truncate. 17. *M. americana*.
  - II. Lateral lobes with only the upper divided or neither, the ends narrowed, not obliquely truncate. 19. *M. mahabuleshwarsensis*.
- D. Polar lobe divided laterally.
  - I. Semicell three lobed, sides with a conical projection above the basal lobes. 20. *M. Nordstedtiana*.
  - II. Semicell five lobed, lobes separated by broadly rounded sinuses. 21. *M. muricata*.
- E. Polar lobe with interlocking teeth so that cells are united into filaments, lateral lobes with their divisions arranged parallel to those of the opposite side. 22. *M. foliacea*.

1. MICRASTERIAS OSCITANS Ralfs in Jenner's Flora of Tunbridge Wells, 1845, p. 198; Brit. Desm., 1848, p. 76, pl. 10, fig. 2; Wolle, Desm. U. S., 1884, p. 116, pl. 33, figs. 3, 4; W. & G. S. West, Brit. Desm., 1905, p. 78, pl. 41, figs. 1-4. This species has been reported from New England by three observers; Massachusetts (*Wolle*), Lake Quinsigamond, Worcester (*Stone*), Rhode Island, near Providence (*Bailey*). I have not as yet seen undisputed material from New England. *Bailey* at least had this species for I have found excellent drawings of the typical form among his notes.

2. MICRASTERIAS LATICEPS Nordst., Desm. Brasil., 1870, p. 220, pl. 2, fig. 14; Wolle, Desm. U. S., 1884, p. 115, pl. 37, figs. 4, 5. *M. incisa* Bail., Micr. obs., 1851, p. 142, pl. 1, fig. 13 (*non Bréb.*). *M. disputata* Wood, Fr. Alg., 1873, p. 142, pl. 13, fig. 4. Cells of medium size, a little broader than long, deeply constricted, semicell three-lobed, polar lobe nearly as wide as the cell, lateral interlobular inci-

sions acute, polar lobe acute at the ends, fusiform, lateral lobes bifid at the tips, cell wall minutely punctate. Length 112–150  $\mu$ , breadth 112–198  $\mu$ , polar lobe 110–170  $\mu$ , isthmus 15–31  $\mu$ . Me.: Bog between Orono and Bangor, frequent (*W. West*). N. H.: Pudding Pond, North Conway, rare! Hill's Pond, Alton (*H. C. no. 664*)! Mass.: Lake Quinsigamond, Worcester (*Stone*); Carver's Pond, Bridgewater! Lake Watuppa, Fall River (*H. C. no. 7*)! Plymouth (*H. C. no. 660*)! Westport (*H. C. no. 702*)! Sandwich! Eastham! R. I.: Near Providence (*Bailey*); Newport (*Leidy*); Portsmouth! Nyatt (*H. C. no. 673*)! This species as will be seen by the above list of stations is well distributed. It never seems to be abundant however, scattered specimens being the rule in all material examined.

3. MICRASTERIAS PINNATIFIDA (Kütz.) Ralfs, Brit. Desm., 1848, p. 77, pl. 10, fig. 3; Wolle, Desm. U. S., 1884, p. 116, pl. 37, figs. 7, 8; Johnson, Species of Micrasterias, 1894, p. 58, pl. 6, figs. 5, 6; W. & G. S. West, Brit. Desm., 1905, p. 80, pl. 41, figs. 7–11, 13. *Euastrum pinnatifidum* Kütz., Phyc. Germ., 1845, p. 134. *Euastrum* No. 7, Bailey, Amer. Bacill., 1841, pl. 3, fig. 29. Cells small, slightly broader than long, deeply constricted, sinus open; semicells three lobed, lateral interlobular incisions deep and broadly rounded; polar lobe narrower than the cell, but spreading, the apices minutely bifid, cell wall minutely punctate. Length 53–65  $\mu$ , breadth 62–75  $\mu$ , polar lobe 46–55  $\mu$ , isthmus 9.5–13  $\mu$ . Me.: Orono (*Harvey, W. West*); Scarboro' (*W. West*). N. H.: Intervale! Pudding Pond, North Conway! Hill's Pond, Alton (*H. C. no. 668*)! Mass.: Lake Quinsigamond, Worcester (*Stone*); Medford (*H. C. no. 701*)! Sessaquin Lake, Middleboro (*H. C. no. 652*)! R. I.: Wainskut Pond, North Providence (*Bailey*); Nyatt! This small species is more commonly found in numbers than the preceding species, although perhaps not any more widely distributed as far as New England is concerned. Several varieties have been recorded and described from New England. In abundant material it has been shown that this species in common with others of this genus is very variable within certain limits (*Johnson, Bot. Gaz., 1894*). Specimens were found in which one semicell was typical, the other being var. *inflata* Wolle. Var. *divisa* West also occurs in a similar manner. A trigonal form from Orono, occurring with the typical form and both var. *inflata* and var. *divisa* was named var. *trigona* by West. Such forms which are evidently monstrosities seem hardly worthy of varietal rank. Thus *M. pinnati-*

*vida* may be seen to be variable in the same lot of material within certain limits.

4. MICRASTERIAS ARCUATA Bailey, Micr. obs., 1851, p. 37, pl. 1, fig. 6; Wolle, Desm. U. S., 1884, p. 117, pl. 38, fig. 5. Mass.: Lake Quinsigamond (*Stone*).

4a. MICRASTERIAS ARCUATA, var. EXPANSA (Bailey) Nordst., Alg. Brasil., 1877, p. 23, fig. II, 5, 6, and b in text. *M. expansa* Bailey, Micr. obs., 1851, p. 37, pl. 1, fig. 7; Wolle, Desm. U. S., 1884, p. 117, pl. 37, fig. 12. Mass.: Lake Quinsigamond, Worcester (*Stone*). These records are all there are for New England.

5. MICRASTERIAS DEPAUPERATA Nordst., var. KITCHELII (Wolle) W. & G. S. West, Some N. Amer. Desm., 1896, p. 239; Cushman, Notes on Micrasterias, 1904, p. 396, fig. 2 in text. *Micrasterias Kitchelii* Wolle, Bull. Torrey Club, 1880, p. 45, pl. 5, fig. M; Desm. U. S., 1884, p. 116, pl. 37, figs. 1–3. Cells of medium size, about as long as broad, deeply constricted, sinus open: semicells barely five lobed, the lateral lobes being divided by a rounded incision of slight depth, polar lobe widely spreading, separated from the lateral lobes by a fairly deep, broadly rounded incision, the width across the distal part of the lateral lobes, slightly less than the entire width of the cell. Extremities of all the lobes bifid. Length 125  $\mu$ , breadth 125  $\mu$ , polar lobe 75–100  $\mu$ . Mass.: Gilder Pond, Mt. Everett, Mount Washington (*Wolle*). Although I collected in Gilder Pond in May 1907 I failed to find this or any other form of *M. depauperata*. Due to the late spring few desmids were present. Wolle's material was collected in August.

5a. MICRASTERIAS DEPAUPERATA Nordst., var. WOLLEI Cushman, Notes on Micrasterias, 1904, p. 396, fig. 3 in text. *M. Kitchelii* Wolle, var., Desm. U. S., 1892, p. 129, pl. 42, fig. 2. *M. depauperata* W. & G. S. West, Some N. A. Desm., 1896, p. 238, pl. 14, fig. 1. Cells larger than in the preceding, somewhat longer than broad, the lateral lobes even less divided by a very shallow sinus, apical lobe narrower, width across the distal portion of the lateral lobes only about three fourths of the whole width of the cell; cell wall punctate. Length 140–155  $\mu$ , breadth 130–145  $\mu$ , polar lobe 90–100  $\mu$ , isthmus 21–27  $\mu$ . N. H.: Pudding Pond, North Conway, rare! Mass.: Tewksbury (*Lagerheim*); Lake Watuppa, Fall River, common (*H. C. no. 35*)! This is the only form of *M. depauperata* that I have seen from New England. It seems to be a rare species and in but one of the localities was it at all common.

6. MICRASTERIAS TRUNCATA (Corda) Bréb., in Ralfs, Brit. Desm., 1848, p. 75, pl. 8, fig. 4, pl. 10, fig. 5; Wood, Fr. Alg., 1873, p. 144, pl. 21, fig. 15; Wolle, Desm. U. S., 1884, p. 114, pl. 38, fig. 6; W. & G. S. West, Brit. Desm., 1905, p. 82, pl. 42, figs. 1-8, pl. 45, figs. 5, 6. *Cosmarium truncatum* Corda, Alm. de Carlsbad, 1834, pp. 180, 206, pl. 2, figs. 23, 24. *M. crenata* Bréb., in Ralfs, Brit. Desm., 1848, p. 75, pl. 7, fig. 2, pl. 10, fig. 4; W. & G. S. West, Brit. Desm., 1905, p. 85, pl. 42, figs. 10-13. *Euastrum No. 3* Bailey, Amer. Bacill., 1841, p. 294, pl. 3, fig. 24. Cells small, very slightly longer than broad, medium sinus deep and narrow, polar lobe wide, in general fusiform, lateral angles acuminate or bifid, end of the lobe either broadly rounded or slightly retuse; lateral lobes two on each side separated from the polar lobe by a comparatively deep sinus, slightly open; sinus between the lateral lobes shallow and narrowly open, ultimate lobules variable, usually each lobe with two lobules which may have two projections or none. Length 86-113  $\mu$ , breadth 80-110  $\mu$ , polar lobe 55-81  $\mu$ , isthmus 14-22  $\mu$ . Me.: Orono (*Harvey*, *W. West*); Spencer Pond, East Middlesex (*H. C. no. 629*)! Mud Pond, Township Range! Kittery! Bridgton! N. H.: Hanover (*Edwards*); Intervale! Pudding Pond, North Conway! North Woodstock! Mass.: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); Reading! Lake Watuppa, Fall River (*H. C. no. 38*)! Sandwich! Eastham! Chilmark! Squam Pond, Nantucket! R. I.: Wainskut Pond, North Providence (*Bailey*). As various gradations occur between typical *M. truncata* and the form known as *M. crenata* Bréb., it seems best not to use the two names. Especially is this true when in American specimens one finds what would pass for typical *M. crenata* making up one semicell and the other having the retuse polar lobe and the lateral lobes of typical *M. truncata*. Since noting such specimens it has seemed best to place all the forms under *M. truncata*. For purposes of distinguishing between the two extremes, the form with the deeper and more rounded polar lobe and the less deeply incised lateral lobes may be known as *M. truncata* (Corda) Bréb., var. **crenata** (Bréb.).

7. MICRASTERIAS JENNERI Ralfs, Brit Desm., 1848, p. 76, pl. 11, fig. 1; Wood, Fr. Alg., 1873, p. 146, pl. 13, fig. 7; W. & G. S. West, Brit. Desm., 1905, p. 86, pl. 42, fig. 14, pl. 43, figs. 1, 2. Me.: Orono (*Harvey*), "with truncata." This is the only New England record for this species. It is worthy of note that W. West does not record it from his material from the same locality.

8. MICRASTERIAS CONFERTA Lund., var. HAMATA Wolle, Bull. Torrey Club, 1883, p. 19, pl. 27, fig. 1; Desm. U. S., 1884, p. 114, pl. 38, figs. 3, 4; W. & G. S. West, Some N. A. Desm., 1896, p. 241, pl. 14, figs. 8, 9; Brit. Desm., 1905, p. 90, pl. 43, figs. 10, 11. Cells of medium size, deeply constricted, with a linear sinus, semicells five lobed, interlobular sinuses narrow except those between the lateral and polar lobes, these being widely gaping, polar lobe cuneate, the distal end broadly extended laterally and the angles uncinata with tooth-like projections and with two pairs of small teeth at either side of the apical notch, lateral lobes twice divided dichotomously by shallow sinuses, cell wall coarsely punctate. Length  $106\ \mu$ ; breadth  $100\ \mu$ , polar lobe,  $43.4\ \mu$ , isthmus  $12.4\ \mu$ . Me.: Spencer Pond, East Middlesex (*H. C. no. 604*)! Mass.: Mt. Everett, Mount Washington (Wolle): Lake Quinsigamond, Worcester (*Stone*).

9. MICRASTERIAS APICULATA (Ehrenb.) Menegh., Synops. Desm., 1840, p. 216; W. & G. S. West, Brit. Desm., 1905, p. 97, pl. 47, figs. 1, 2. *M. fimbriata*, forma *apiculata* Wolle, Desm. U. S., 1884, p. 110, pl. 36, fig. 2. *M. furcata* Wood, Fr. Alg., 1873, p. 144, pl. 13, fig. 5. *Euastrum apiculatum* Ehrenb., Organ. kl. Raum, 1834, p. 245; Infus., 1838, p. 161, pl. 12, fig. II. Cells large, slightly longer than broad, sinus deep, narrowly linear, opening outward; semicells five lobed, polar lobe exserted, sides nearly parallel, except at the distal end which is expanded, angles with a pair of stout diverging spines, on the inner side a stout incurved spine at each side and a smaller spine on either side of the median notch; lateral lobes nearly equal, each dichotomously twice divided, the resulting divisions each with a pair of curved spines, all sinuses narrow except those between the lateral and polar lobes, these opening much more widely; surface of the cell with many minute spines, with four larger ones just above the isthmus in each semicell and arranged in a quadrate manner. Length  $240\text{--}254\ \mu$ , breadth  $200\text{--}217\ \mu$ , polar lobe  $42\text{--}46\ \mu$ , isthmus  $31\ \mu$ . N. H.: Hill's Pond, Alton (*H. C. no. 666*)! Mass.: Medford! There is considerable variation in the spines of the polar lobe. In some cases they are very large and strongly curved.

9a. MICRASTERIAS APICULATA, subsp. FIMBRIATA (Ralfs) Nordst., Bornh. Desm., 1888, p. 190; W. & G. S. West, Brit. Desm., 1905, p. 99, pl. 46, fig. 6, pl. 47, figs. 2, 3. *M. fimbriata* Ralfs, Brit. Desm., 1848, p. 71, pl. 8, fig. 2; Wolle Desm. U. S., 1884, p. 109, pl. 36, fig. 1. *M. fimbriata* var. *nuda* Wolle, Bull. Torrey Club, 1880, p. 45; Desm.

U. S., 1884, p. 110, pl. 36, fig. 4. *M. fimbriata*, var. *elephanta* Wolle, l. c. fig. 3. *M. fimbriata*, forma *simplex* Wolle, l. c. fig. 8. *M. subfimbriata* Wolle, l. c. fig. 7. In this variety the surface usually has no ornamentation of spines, the spines on the polar lobe are fewer and smaller and the whole lobe less projecting; the basal lobulations of the lateral lobes often project beyond the others. Length 186–229  $\mu$ , breadth 180–205  $\mu$ , polar lobe 40–50  $\mu$ , isthmus 38  $\mu$ . Me.: Pushaw Stream (*Harvey*); Scarborough, frequent (*W. West*). N. H.: Rochester (*Wolle*). Mass.: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Carver's Pond, Bridgewater! Lake Watuppa, Fall River (*H. C. no. 15*)! Wolle figured and named many forms of this variable species but they seem to be but variations of the same thing. His forms are included in the above synonymy.

10. MICRASTERIAS DENTICULATA Bréb., Alg. Falaise, 1835, p. 54, pl. 8; Ralfs, Brit. Desm., 1848, p. 70, pl. 7, fig. 1; pl. 8, fig. 1; Wolle, Desm. U. S., 1884, p. 109, pl. 34, figs. 4–8 (*forms*); W. & G. S. West, Brit. Desm., 1905, p. 105, pl. 49, figs. 1–7, pl. 50, figs. 1, 2. Cells large, slightly longer than broad, outline subcircular, deeply constricted, sinus very narrowly linear as are the interlobular ones; semicells five lobed, polar lobe broadening distally, concave at the apex with a median notch, angles rounded, lateral lobes broadly cuneate, dichotomously three times divided, ultimate divisions retuse, without spines; surface without ornamentation. Length 234–410  $\mu$ , breadth 195–300  $\mu$ , polar lobe 65–76  $\mu$ , isthmus 25–42  $\mu$ . Me.: Penobscot River at Orono (*Harvey*). N. H.: Hanover (*Edwards*); Intervale! Pudding Pond, North Conway! Mass.: Carver's Pond, Bridgewater! Lake Watuppa, Fall River! R. I.: Wainskut Pond, North Providence (*Bailey*). This is one of the few species without spines on some portion of the cell.

10a. MICRASTERIAS DENTICULATA, var. ANGULOSA (Hantzsch) W. & G. S. West., Alg. N. Ireland, 1902, p. 30; Brit. Desm., 1905, p. 107, pl. 50, figs. 3, 4. *M. angulosa* Hantzsch in Rab. Alg., 1862, no. 1407. *M. denticulata* Wood, Fr. Alg., 1873, p. 145, pl. 13, fig. 6. *M. radiosa*, var. *punctata* West, Desm. Mass., 1889, p. 20, pl. 2, figs. 1, 2. Cells more angular than in the typical form, the widest part of the semicell usually above the base, lateral lobes but twice divided, surface coarsely punctate. Length 245–310  $\mu$ , breadth 210–300  $\mu$ , polar lobe 68–77.5  $\mu$ , isthmus 28  $\mu$ . N. H.: North Woodstock! Mass.: Amherst (*W. West*); Lake Watuppa, Fall River (*H. C. no. 34*)! This variety



grows to a very considerable size, its angular form and coarsely punctate surface giving it a very different appearance from the typical form than which it seems to be more rare.

11. MICRASTERIAS SOL (Ehrenb.) Kütz., Spec. Alg., 1849, p. 171; W. & G. S. West, Brit. Desm., 1905, p. 95, pl. 46, figs. 1, 2. *M. radiosa* Ralfs, Brit. Desm., 1848, p. 78, pl. 8, fig. 3; Wolle, Desm. U. S., 1884, p. 109, pl. 31, fig. 2. *Euastrum sol* Ehrenb., Mikr. Leb. Sud. u. N. Amer., 1843, p. 413, pl. 4, fig. 16. Cells large, circular in general outline, very deeply constricted, sinus narrowly open, the sides undulate, semicells five lobed, all the sinuses deep; polar lobe with nearly parallel sides, broadest distally, apex concave with a slight median notch, the outer angles each with two teeth, a single tooth within at either side of the median notch; upper lateral lobes larger than the lower ones and often with more lobules, lower lobes dichotomously twice divided to form four equal lobules, the apices variously toothed; cell wall unornamented. Length 140–220  $\mu$ , breadth 125–235  $\mu$ , polar lobe 25–34  $\mu$ , isthmus 20–25  $\mu$ . N. H.: Pudding Pond, North Conway! Hill's Pond, Alton! Mass.: Lake Quinsigamond, Worcester (*Stone*); Reading! Carver's Pond, Bridgewater: R. I.: Near Providence (*Bailey*).

11a. MICRASTERIAS SOL, var. ORNATA Nordst., Point sfor. Skand. Vaxt., 4, 1880, p. 25; W. & G. S. West, Brit. Desm., 1905, p. 97, pl. 46, figs. 3, 4. *M. radiosa*, var. *ornata* Nordst., Desm. Brasil., 1870, p. 223, pl. 2, fig. 11. *M. radiosa* Wolle, Desm., U. S., 1884, pl. 31, fig. 3. *M. radiosa* var. *Wollei* Cushman, Notes on Micrasterias, 1904, p. 394. Cells similar to those of the typical form but with a row of minute teeth bordering the sinus and the interlobular incisions except on the polar lobe. Length 152  $\mu$ , breadth 146  $\mu$ , polar lobe 28  $\mu$ . Mass.: Chilmark, Marthas Vineyard.

11b. MICRASTERIAS SOL, var. **Swainii** (Hastings) n. comb. *M. Swainii* Hastings, in Wolle, Desm. U. S., 1892, p. 119, pl. 42, fig. 1. *M. radiosa* var. *Swainii* W. & G. S. West, Some N. A. Desm., 1896, p. 240, pl. 13, fig. 30. A variety with the basal lobules of each semicell simple and produced into elongated processes. Length 150–160  $\mu$ , breadth 151–164  $\mu$ , polar lobe 34  $\mu$ , isthmus 11.5–16  $\mu$ . N. H.: Rochester (*Hastings*). Mass.: Reading (*H. C. no. 644*)!

12. MICRASTERIAS PAPILLIFERA Bréb., in Ralfs, Brit. Desm., 1848, p. 72, pl. 9, fig. 1; Wolle, Desm. U. S., 1884, p. 109, pl. 32, figs. 8, 9; W. & G. S. West, Brit. Desm., 1905, p. 91, pl. 44, figs. 1,

2, 7; Cushman, Zygo-sp. Desm., 1905, p. 225, pl. 7, figs. 7, 7a. Cells of medium size, slightly longer than broad, nearly circular in general outline; deeply constricted, sinus linear; semicells five lobed, separated by linear sinuses; polar lobe broadening distally with nearly straight or slightly concave sides, apex concave with a median notch, the lateral angles bifid and a tooth at each side of the median notch; lateral lobes cuneate, about equal in size, divided twice dichotomously, the ultimate divisions emarginate; cell wall with a row of acute granules on either side of the sinus and interlobular incisions. Zygo-spore subglobose, with strong spines, simple or furcate at the apex. Length 152–155  $\mu$ , breadth 135–148  $\mu$ , polar lobe 36–43  $\mu$ , isthmus 15.5–21  $\mu$ . Zygo-spore: length with spines 103–105  $\mu$ , without spines 75  $\mu$ , breadth with spines 95  $\mu$ , without spines 75  $\mu$ . Me.: Orono (*W. West*); Bridgeton! N. H.: Pudding Pond, North Conway! Mass.: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Reading (*H. C. no. 734*)! also with zygo-spores! R. I.: Near Providence (*Bailey*). The zygo-spores that I have observed had the majority of the spines simple, occasionally a few with the apices once furcate but none as much furcate as in Ralfs' figure. The material from Reading had an abundance of zygo-spores associated with the empty semicells.

13. MICRASTERIAS ROTATA (Grev.) Ralfs, Ann. Nat. Hist., 1844, p. 259, pl. 6, fig. 1; Brit. Desm., 1848, p. 71, pl. 8, fig. 1a, (b?); Wolle, Desm. U. S., 1884, p. 109, pl. 34, figs. 1, 2; W. & G. S. West, Brit. Desm., 1905, p. 102, pl. 48, figs. 1–6. *Echinella rotata* Grev., in Hooker, Br. Fl., 2, 1833, p. 398. Cells large, slightly longer than broad, general outline broadly elliptical; deeply constricted, sinus narrowly linear; semicell five lobed, polar lobe broadening distally, apex with a median notch, the angles with two spines, lateral lobes unequal, the basal ones smaller, each divided dichotomously three times, the ultimate divisions with spinose angles, interlobular sinuses narrowly linear, those between the lobules broader; no surface ornamentation. Length 242  $\mu$ , breadth 226  $\mu$ , polar lobe 57  $\mu$ , isthmus 29  $\mu$ . Me.: Penobscot River, near Orono (*Harvey*); Spencer Pond, East Middlesex (*H. C. no. 614*)! N. H.: Pudding Pond, North Conway! Mass.: Amherst (*W. West*); Lake Quinsigamond, Worcester (*Stone*); Westport (*H. C. no. 739*)! R. I.: Wainskut Pond, North Providence (*Bailey*). This is one of our largest and showiest desmids.

14. MICRASTERIAS TORREYI Bailey, in Ralfs, Brit. Desm., 1848,

p. 210, pl. 35, fig. 5; Wolle, Desm. U. S., 1884, p. 108, pl. 30, figs. 1–8. *M. Pseudotorreyi* Wolle, Bull. Torrey Club, 1883, p. 19, pl. 27, fig. 2; Desm. U. S., 1884, p. 108, pl. 32, fig. 1. Cells large, generally sub-circular in outline, deeply constricted, sinus at first narrowly linear then opening outward; semicells five lobed, polar lobe broadening distally, sides concave, end emarginate with or without a median notch, angles acute or with a truncate emargination; lateral lobes unequal, in the more common form, the lower with two, the upper with three lobules, usually concave with acute angles, occasionally the lobules again divided and the interlobular incisions narrower but usually opening widely outward; surface without ornamentation. Length 215–280  $\mu$ , breadth 170–310  $\mu$ , polar lobe 47–90  $\mu$ , isthmus 25–38  $\mu$ . N. H.; Pudding Pond, North Conway! Mass.: Mt. Everett, Mount Washington (*Wolle*); Lake Quinsigamond, Worcester (*Stone*); Reading! Randolph! There seems to me no doubt that *M. Pseudotorreyi* Wolle is a synonym of *M. Torreyi*. It is reported only from the localities where *M. Torreyi* is found and in my own material specimens were found which bridge the gap in size, and the form of the lobes is variable in all the specimens I have seen. In some cases specimens were nearly as regular as in Wolle's figure but something must be allowed for the conventionalizing of Wolle's figures.

15. MICRASTERIAS RADIATA Hass., Br. Alg., 1845, p. 386, pl. 90, fig. 2; W. & G. S. West, Brit. Desm., 1905, p. 113, pl. 52, figs. 1–9. *M. melitensis* Ralfs, Ann. Nat. Hist., 1844, p. 260, pl. 6, fig. 2 (*not M. melitensis Menegh. 1840*). *M. furcata* Ralfs, Brit. Desm., 1848, p. 73, pl. 9, fig. 2 (*not M. furcata Ag. 1827*); Wolle, Desm. U. S., 1884, p. 111, pl. 35, figs. 5, 6; Johnson, Bot. Gaz., 1894, p. 58, pl. 6, figs. 8–14. *M. pseudofurcata* Wolle, Bull. Torrey Club, 1881, p. 1, pl. 6, fig. 3; Desm. U. S., 1884, p. 111, pl. 35, fig. 4. *M. furcata* var. *simplex* Wolle, Bull., Torrey Club, 1885, p. 128, pl. 51, figs. 6, 7; Fr. Alg., 1887, p. 40, pl. 59, figs. 6, 7. Cells of medium size, slightly longer than broad; very deeply constricted, sinus widely open, often partly closed by the basal lobules; semicells five lobed, polar lobe with parallel sides below, then widely expanding into diverging elongated processes; apex furcate; lateral lobes usually once divided but very variable, ends furcate, lobules diverging; cell wall unornamented. Length 145–192  $\mu$ , breadth 124–160  $\mu$ , polar lobe 62–105  $\mu$ , isthmus 18–30  $\mu$ . Me.: Bog between Orono and Bangor; Scarborough, frequent (*W. West*). Vt.: Johnson! N. H.: Noone's Station! Pudding

Pond, North Conway! Mass.: Lake Quinsigamond, Worcester (*Stone*); Tewksbury! Medford (*H. C. no. 712*)! Wellesley! Carver's Pond, Bridgewater! Lake Watuppa, Fall River! Nokechoke Lake, Westport! Milford Pond, Swansea (*H. C. no. 669*)! R. I.: Worden's Pond, near Providence (*Bailey*); Nyatt (*H. C. no. 636*)! As shown by Johnson this species is very variable, all gradations existing between *var. simplex* Wolle and the typical form, and the two semicells of a single specimen often being considerably different. The angle at which the lateral lobes diverge is also very variable.

15a. MICRASTERIAS RADIATA, var. **dichotoma** (Wolle) n. comb.; *M. dichotoma* Wolle, Bull. Torrey Club, 1884, p. 14; Desm. U. S., 1884, p. 111, pl. 52, fig. 2. Similar to the type but with the lobes much more spreading and drawn out laterally. Length 190–250  $\mu$ , breadth 155–200  $\mu$ , polar lobe 93–111  $\mu$ , isthmus 13–18  $\mu$ . Mass.: Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); Nokechoke Lake, Westport (*H. C. no. 645*)! This seems best considered a variety of *M. radiata* as it differs in but minor characters, the drawn out condition of the lobes being the main thing that distinguishes it.

16. MICRASTERIAS CRUX-MELITENSIS (Ehrenb.) Hass., Br. Alg., 1845, p. 386, pl. 90, fig. 7; Ralfs, Brit. Desm., 1848, p. 73, pl. 9, fig. 3; Wolle, Desm. U. S., 1884, p. 111, pl. 35, fig. 3; W. & G. S. West, Brit. Desm., 1905, p. 116, pl. 53, figs. 1–3. *Euastrum crux-melitensis* Ehrenb., Entw. d. Inf., 1832, p. 82. Mass.: Lake Quinsigamond, Worcester (*Stone*). This is the only New England record for this species. I have never seen specimens which I could refer to this species.

17. MICRASTERIAS AMERICANA (Ehrenb.) Ralfs, Brit. Desm., 1848, p. xix; Wood, Fr. Alg., 1873, p. 143, pl. 12, fig. 17; Wolle, Desm. U. S., 1884, p. 112, pl. 32, fig. 2; W. & G. S. West, Brit. Desm. 1905, p. 117, pl. 53, figs. 4, 5, pl. 54, figs. 1–3. *M. morsa* Ralfs, Brit. Desm., 1848, p. 74, pl. 10, fig. 1. *Euastrum americanum* Ehrenb. Mikr. Leb. Sud. u. N. Amer., 1843, p. 413, pl. 4, fig. I. 15. *Euastrum No. 4* Bailey, Amer. Bacill., 1841, p. 295, pl. 3, fig. 25. Cells of medium size, slightly longer than broad, deeply constricted, sinus opening outward, semicells five lobed, polar lobe large and broadening distally, apex widely retuse, each angle extended into a broad process, denticulate at the end, from near the base of each of these processes is a shorter similar process, each on the opposite side of the polar lobe;

polar lobe widely separated from the lateral ones, which are scarcely separated from one another by a shallow open sinus, each lobe once divided, the lobules obliquely truncated and denticulate; surface of the cell with scattered denticulate granules, most numerous towards the ends of the lobes, and an irregular group centrally above the isthmus on each semicell. Length 124–158  $\mu$ , breadth 105–138  $\mu$ , polar lobe 50–75  $\mu$ , isthmus 18–28  $\mu$ . Me.: Orono (*Harvey*). N. H.: North Woodstock! Mass.: Amherst (*W. West*); Lake Quinsigamond Worcester (*Stone*); Stony Brook, Weston! Misery Island, off Beverly Farms! Medford! Plainville! Pondville! Carver's Pond, Bridgewater! Swansea! Framingham (*H. C. no. 726*)! R. I.: Near Providence (*Bailey*). This species seems to be common in material from southern New England but has been met with very seldom in collections north of Massachusetts. Like other species of this genus it is variable. The polar lobe assumes various forms yet none of them with the exception of the following variety is united with other distinctive characters. The four large granules at the apex of the terminal lobe seem to be lacking more often than they are present and the whole cell is often nearly smooth.

17a. MICRASTERIAS AMERICANA, var. RECTA Wolle, Bull. Torrey Club, 1876, p. 122; 1881, pl. 6, fig. 2; Desm. U. S., 1884, p. 112, pl. 32, fig. 3; W. & G. S. West, Brit. Desm., 1905, p. 119, pl. 54, fig. 4. Extremities of the processes of the polar lobe all very short and rounded, apex of the polar lobe nearly straight, sinuses separating the lateral lobes and lobules reduced and a much more even outline developed than in the type. Length 143  $\mu$ , breadth 121  $\mu$ , polar lobe 65  $\mu$ , isthmus 28  $\mu$ . N. H.: North Woodstock! Mass.: Carver's Pond, Bridgewater! Framingham (*H. C. no. 703*)! Pond near Old North Cemetery, Nantucket! There are varying gradations between this variety and the type from which it is difficult to group but as a rule the variety seems to be distinct. It is much less common in New England than the typical form.

18. MICRASTERIAS RINGENS Bailey, var. SERRULATA Wolle, Bull. Torrey Club, 1885, p. 128, pl. 51, fig. 15; Fr. Alg., 1887, p. 41, pl. 59, fig. 15; W. & G. S. West, Some Desm. U. S., 1898, p. 296. Length 156  $\mu$ , breadth 152  $\mu$ . N. H.: Laconia (*H. J. no. 650, 679*). Whether this is the same as *M. mahabuleshwariensis* Hobson or not seems to be an open question. Upon examining Johnson's slides nos. 650 and 679 I was unable to find the specimens in condition for critical exami-

nation. This is the only New England record and must rest upon the specimens which Johnson saw. "These forms appear to differ from many specimens of *M. mahabuleshwariensis* that we have seen only in the absence of the additional apical process" (W. & G. S. West 1898, p. 296).

19: MICRASTERIAS MAHABULESHWARENSIS Hobson, Ind. Desm., 1863, pp. 168, 169, text fig.; Wolle, Desm. U. S., 1884, p. 112, pl. 37, fig. 10; Johnson, New and rare Desm. U. S., II, 1895, p. 292; W. & G. S. West, Brit. Desm., 1905, p. 121. *M. americana*, var. *Hermanniana* Wolle, Desm. U. S., 1884, p. 112, pl. 32, fig. 5. This species resembles *M. americana* but differs in the following points. Cells larger, lower and often the upper lateral lobes undivided, ornamentation consisting of a series of acute denticulations bordering the interlobular sinuses, a central ring of four large granules above the isthmus, and often a single granule just above the isthmus. Length 151–220  $\mu$ , breadth 135–190  $\mu$ , polar lobe 75–100  $\mu$ , isthmus 19–22  $\mu$ . N. H.: Meredith, rare (*Johnson*). Mass.: Lake Quinsigamond, Worcester (*Stone*); Carver's Pond, Bridgewater! The measurements are those given by W. & G. S. West, British Desmids. This species is closely related to *M. americana* if it is not a variety of it. It has a more southern distribution and is much more common in material from our southern states. It is rare in New England.

20. MICRASTERIAS NORDSTEDTIANA Wolle, Bull. Torrey Club, 1884, p. 15; Desm. U. S., 1884, p. 113, pl. 52, figs. 3–5; Johnson, Bull. Torrey Club, 1895, p. 292, pl. 239, fig. 14; W. & G. S. West, Some N. A. Desm., 1896, p. 239, pl. 14, fig. 4. Cells somewhat longer than wide, semicells three lobed usually, but developing two rudimentary lateral lobes occasionally; polar lobe spreading, divided laterally to form two arms of unequal length on either side, ends with two or more spines, basal lobes bifurcate, spreading, ends spinose, sinus deep, somewhat gaping, rudimentary lateral lobes varying from a small conical projection to a considerable lobe ending in a pair of spines; surface smooth. Length 134–191  $\mu$ , breadth 115–171  $\mu$ , isthmus 14–27  $\mu$ . N. H.: Meredith, rare (*Johnson*).

21. MICRASTERIAS MURICATA (Bailey) Ralfs, Brit. Desm., 1848, p. 210; Wolle, Desm. U. S., 1884, p. 118, pl. 31, figs. 4–7. *M. muricata*, var. *tumida* W. & G. S. West, Some N. A. Desm., 1896, p. 240, pl. 14, fig. 7. *Euastrum muricatum* Bailey, Castk. Desm., 1846, p. 126, figs. 1, 2 in text. Cells large, semicells divided laterally into

three wide portions, connected by narrowed sections, the interlobular incisions deep but broadly rounded, sinus deep, acute angled, median and apical lobes split laterally, basal one split into three parts, the middle one of the three longest and occasionally bifid, apices of all the lobes minutely toothed, cell wall punctate. Length 160–195  $\mu$ , breadth 120–155  $\mu$ , polar lobe 120–140  $\mu$ , isthmus 21–31  $\mu$ . Me.: Spencer Pond, East Middlesex (*H. C. no. 633*)! N. H.: Pudding Pond, North Conway. Rare! Mass.: Lake Quinsigamond, Worcester (*Stone*); Tewksbury (*Lagerheim*); Carver's Pond, Bridgewater! Westport (*H. C. no. 689*)! R. I.: near Providence (*Bailey*).

21a. MICRASTERIAS MURICATA, forma MINOR Cushman, *Desm. Flora N. H.*, 1905, p. 254. A form in which the cells are much smaller than in the typical form of the species. Length 123  $\mu$ , breadth 84  $\mu$ , polar lobe 84  $\mu$ , isthmus 16  $\mu$ . N. H.: Intervale!

22. MICRASTERIAS FOLIACEA Bailey, in *Ralfs. Brit. Desm.*, 1848, p. 210, pl. 35, fig. 3; *Wolle, Desm. U. S.*, 1884, p. 118, pl. 38, figs. 10, 11; *Johnson, Bot. Gaz.*, 1894, p. 56, pl. 6, figs. 1–4. Cells small, subquadrate in outline, deeply constricted, sinus narrow, linear throughout its length, semicell five lobed, lateral lobes with their outer margins nearly straight, the two sides of the semicell parallel, the upper of the lateral lobes being elongated and somewhat curved, each lateral lobe divided into two or four lobules, the upper usually with the distal lobule shortest; polar lobe rhomboid, end with a quadrate incision with a broad plate like projection on either side, between which are two teeth at one side and two on the reverse side, the opposite polar lobe exactly reversed, the shape allowing the interlocking of the cells to form long linear series: surface typically smooth. Length 80–96  $\mu$ , breadth 80–85  $\mu$ , polar lobe 36–38  $\mu$ , isthmus 14–15  $\mu$ . N. H.: Laconia, scarce (*H. J. no. 665*) Pudding Pond, North Conway, rare! Mass.: Gilder Pond, Mt. Everett, Mount Washington (*Wolle*); Lake Quinsigamond, Worcester, (*Stone*). R. I.: Worden's Pond, near Providence (*Bailey*). Johnson worked out the structure of the polar lobe in this species and his figures give a better idea of the structure than a description. This is one of our most beautiful and most interesting species. Johnson records filaments with over a hundred cells.

22a. MICRASTERIAS FOLIACEA, var. **granulifera** n. var. Like the type but the surface covered with large irregularly disposed granules. Var. *membrana granulis magnis inordinatim dispositis*. N. H.: Pudding Pond, North Conway!

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